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Enclosed for filing is the patent application of Inventor(s):
MATTHEW P.J. BAKER AND EDWARD S. EILLEY

For: METHOD OF, AND HETEROGENEOUS NETWORK FOR, TRANSMITTING DATA
      PACKETS

ENCLOSED ARE:
[X]   Associate Power of Attorney;
[ ]   Information Disclosure Statement, Form PTO-1449 and copies of
      documents listed therein;
[ ]   Preliminary Amendment;
[X]   Specification (7 Pages of Specification, Claims, & Abstract);
[X]   Declaration and Power of Attorney:
      (1 Pages of a [X]fully executed   [ ]unsigned Declaration);
[X]   Drawing (2 sheets of [X]informal   [ ]formal sheets);
[X]   Certified copy of BRITISH application Serial No. 9913260.7;
[X]   Other: CHARGE AUTHORIZATION
[X]   Assignment to U.S. PHILIPS CORPORATION.

   FEE COMPUTATION

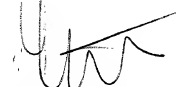| CLAIMS AS FILED				
FOR	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE - 690.00
Total Claims	4 - 20 =	0	X $18 =	0.00
Independent Claims	2 - 3 =	0	X $78 =	0.00
Multiple Dependent Claims, if any			$260 =	0.00
TOTAL FILING FEE			=	$690.00

     **Please charge Deposit Account No. 14-1270 in the amount of
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[ ]Amend the specification by inserting before the first line the
sentence: --This is a continuation-in-part of application Serial
No.   , filed   ---.

Daniel J. Piotrowski, Reg. 42,079
Attorney
(914) 333-9624
U.S. Philips Corporation
580 White Plains Road
Tarrytown, New York 10591
S:\PW\MU22PWA0.CNO

DESCRIPTION

METHOD OF, AND A HETEROGENEOUS NETWORK FOR, TRANSMITTING DATA PACKETS

The present invention relates to a method of, and heterogeneous network for, transmitting data packets over an interface between a first network part and a second network part.

Various protocols are known for handling data packets. The IEEE 1394 protocol relating to high performance serial bus operates using regular cycles of 125μs. Each cycle typically comprises 100μs of isochronous data and 25μs of asynchronous data.

Constant average bit rate isochronous services, such as MPEG, produce a stream of data to be transmitted. The data is divided into data blocks of a constant size. When using the IEEE 1394 protocol in conjunction with MPEG in a heterogeneous network a problem which frequently occurs is that the rate of arrival of the constant size data blocks will not necessarily correspond to the cycle rate on a IEEE 1394 bus. In contrast a device which reserves bandwidth, that is information carrying capacity, for the service on a IEEE 1394 bus has to reserve sufficient bandwidth for the greatest number of such data blocks which will ever have to be transmitted in one 125μs cycle.

The number of data blocks transmitted in each cycle may not be constant, if a non-integer value results from the quotient:

$$\frac{\text{(Required information rate) X (Cycle Duration)}}{\text{(Data Block Size)}}$$

By way of example if the result of the above quotient is 1.01. that is non-integer, it will be necessary to send one data block in each of 99 consecutive cycles, followed by 2 data blocks in the one hundredth cycle.

In order to allow for the cycle which will contain 2 data blocks, sufficient bandwidth has to be reserved for 2 data blocks to be transmitted in every cycle, thus wasting 49.5% of the bandwidth reserved.

This presents particular problems in heterogeneous networks, where the amount of bandwidth reserved in one part of the network may be taken as a measure of the amount of bandwidth required to be reserved in a second part of the network over which the same service is to be transmitted. This may result in excess bandwidth being unnecessarily reserved in the second part of the network. This is especially undesirable if bandwidth is particularly scarce in the second part of the network, for example if it uses wireless technology.

An object of the present invention is to use bandwidth more effectively in heterogeneous networks.

According to one aspect of the present invention there is provided a method of transmitting data packets over an interface between first and second heterogeneous parts, comprising the first part or interface determining the number of data packets being transmitted in a predetermined time and reserving sufficient information carrying capacity in the second part corresponding to at least one data packet in excess of the number determined.

According to a second aspect of the present invention there is provided a heterogeneous network comprising first and second heterogeneous parts, and an interface between the said parts, the first part having means for transmitting data packets and the first part or interface having means for determining the number of data packets being transmitted in a predetermined time, and the second part having means for receiving the data packets transmitted by the first part and means for reserving sufficient information carrying capacity corresponding to at least one data packet in excess of the number determined.

The method in accordance with the present invention enables sufficient information carrying capacity to be reserved in the second part of the network to ensure that the data blocks from a constant average bit rate service are always able to be transmitted. Further the amount of information carrying capacity reserved in the second part of the network may be reduced during transmission of the service.

In one embodiment of the method in accordance with the present invention at the commencement of transmission the amount of information carrying capacity reserved in the second part corresponds to that reserved in the first part and the amount of information carrying capacity reserved is reduced during transmission to at least one packet in excess of the number determined.

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a block schematic diagram of a heterogeneous network,

Figure 2 illustrates a cycle of 125µs and data blocks to be transmitted,

Figure 3 illustrates the transmission of data blocks, and

Figure 4 is a flow chart illustrating the sequence of operations.

In the drawings the same reference numerals have been used to indicate corresponding features.

The heterogeneous network shown in Figure 1 comprises a first wired part 10 consisting of one or more devices 12, 13, 14, such as source(s) of video information for example video cameras and video recorders, and a transceiving device 16 and a second wireless part 18 comprising devices 20, 21, such as television receivers. The network may also comprise a central controller 24 which is involved in communicating directly with the devices 16, 20, 21, and by way of the the device 16 with the wired devices 12, 13 and 14, prior to direct mode communication between the devices in the parts 10 and 18 in time slots allocated by the central controller 24. For convenience of description the first part 10 operates in accordance with the IEEE 1394 protocol and the second part 18 operates in accordance with the Hiperlan protocol.

In operation it is assumed that the device 12, for example a video source, in the wired part 10 wishes to establish an isochronous connection with the device 20 in the wireless part 18. The first wired part 10 operates using a protocol which is packet- and cycle- based such as IEEE 1394.

Information carrying capacity, generally termed bandwidth, corresponding to the greatest number of data blocks DB which will have to be transmitted by the device 16 in a cycle having in this example a duration of 125µs, is reserved on the first part of the network. The device 16 which is responsible for reserving

5   the bandwidth in the second part 18 of the network initially reserves the same amount of bandwidth as was reserved on the first part 10 of the network. Thus for example as shown in Figure 2, a cycle comprises data block DB1 and a fraction of one fifth of the data block DB2 causing enough bandwidth to be reserved in the first part 10 of the network for two data blocks per cycle and

10   causing the device 16 to reserve likewise enough bandwidth in the second part 18 of the network for two data blocks per 250µs.

However when the service begins, the device 16 counts the number N of data blocks DB10 to DB13(Figure 3) arriving in the time T1 from the first part 10 of the network. The device reduces the bandwidth allocation to correspond

15   to (N+1) data blocks per time period T1. The device 16 communicates with the central controller 24 to free up an amount of bandwidth in the second part 18 of the network equal to the difference between the amount of bandwidth initially reserved and

$$\frac{((\text{Number of data blocks received in time T1 from 1st. part of network})+1)X(\text{Size of Data Block})}{T1}$$

20   Thus sufficient bandwidth is always reserved in the second part 18 of the network for one more than the lowest number of data blocks received from the first part 10 of the network in time T1, thereby saving a large amount of extra bandwidth. In Figure 3, four data blocks DB10, DB11, DB12 and DB13

25   are received in the time period T1 but in the second time period T2, where T2 is equal to T1, there are five data blocks DB14 to DB18 which require the entire reserved bandwidth.

Referring to Figure 4, the flow chart starts with block 30 denoting the device 16 signalling to the central controller 24 that it wants to transmit to say

30   the device 20 in the second part 18. Block 32 indicates reserving in the second part 18 bandwidth equivalent to that reserved in the first part 10. Block 34 relates to the commencement of transmission of data blocks by the device 16.

Block 36 relates to the device 16 counting the number of data blocks in successive time periods having a duration T1. Block 38 relates to the device 16 determining the bandwidth (N + 1) to be reserved by the second part 18. Block 40 denotes the excess bandwidth being released for use by other users of the network. Block 42 denotes the end of the process.

In the case of a heterogeneous network in which the predetermined time T1 is not synchronised to the cycles in the first part of the network it may be necessary for the device 16 to allocate bandwidth corresponding to (N+2) data blocks per time period.

Although the present invention has for convenience been described with reference to IEEE 1394 and Hiperlan, the principle can be used with other heterogeneous systems establishing an isochronous connection between two parts.

In the present specification and claims the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Further, the word "comprising" does not exclude the presence of other elements or steps than those listed.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design, manufacture and use of heterogeneous networks and components therefor and which may be used instead of or in addition to features already described herein.

CLAIMS

1.   A method of transmitting data packets over an interface between first and second heterogeneous parts, comprising the first part or interface determining the number of data packets being transmitted in a predetermined time and reserving sufficient information carrying capacity in the second part corresponding to at least one data packet in excess of the number determined.

2.   A method as claimed in claim 1, characterised in that at the commencement of transmission the amount of information carrying capacity reserved in the second part corresponds to that reserved in the first part and in that the amount of information carrying capacity reserved is reduced during transmission to at least one packet in excess of the number determined.

3.   A heterogeneous network comprising first and a second heterogeneous parts, and an interface between the said parts, the first part having means for transmitting data packets and the first part or interface having means for determining the number of data packets being transmitted in a predetermined time, and the second part having means for receiving the data packets transmitted by the first part and means for reserving sufficient information carrying capacity corresponding to at least one data packet in excess of the number determined.

4.   A heterogeneous network as claimed in claim 3, characterised in that said means for reserving initially reserves in the second part the same amount of information carrying capacity as is reserved in the first part and is responsive to signals indicating the number of data packets being transmitted for reducing the amount of information carrying capacity to at least one data packet in excess of the number determined.

ABSTRACT

METHOD OF, AND A HETEROGENEOUS NETWORK FOR, TRANSMITTING DATA PACKETS

A method of transmitting data packets in a heterogeneous network comprising first and second parts (10, 18) and an interface between the parts, comprises a device (16) in the first part(10) or interface determining the number of data packets being transmitted in a predetermined time and reserving sufficient information carrying capacity in the second part (18) corresponding to at least one data packet in excess of the number determined.
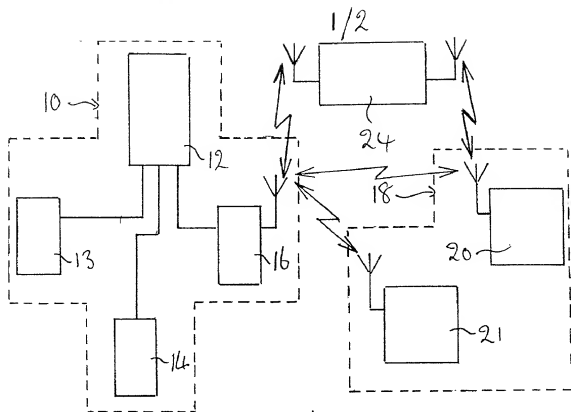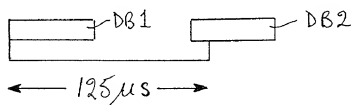
(Figure 1)

1/2

24

10
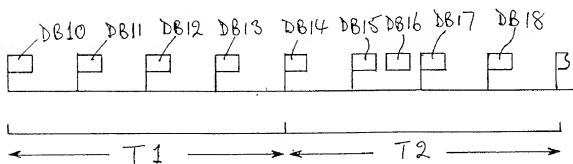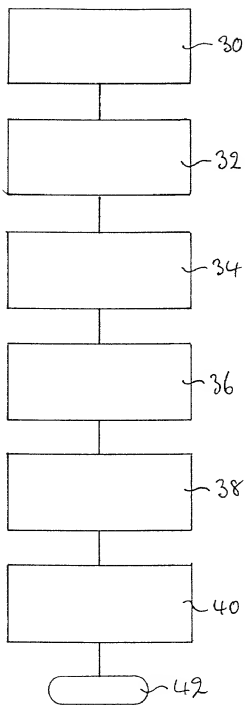
12

13

16

14

18

20

21

Fig. 1

DB1   DB2

← 125 μs →

Fig. 2

DB10 DB11 DB12 DB13   DB14 DB15 DB16 DB17   DB18

3

← T1 → ← T2 →

Fig. 3

Fig. 4.

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD OF , AND A HETEROGENEOUS NETWORK FOR , TRANSMITTING DATA PACKETS

....

....

the specification of which (check one)

☒ is attached hereto

☐ was filed on .... as Application Serial No: .... and was amended on

.... (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56 (a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY Claimed Under 35 U.S.C. 119	
GREAT BRITAIN	9913260.7	08-06-1999	Yes X	No
			Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PRIOR UNITED STATES APPLICATION(S)

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (PATENTED, PENDING, ABANDONED)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Jack E. Haken, Reg. No 26,902

Algy Tamoshunas, Reg. No 27,677

SEND CORRESPONDENCE TO: Corporate Patent Counsel U.S. Philips Corporation 580 White Plains Road Tarrytown, New York 10591	DIRECT TELEPHONE CALLS TO: (Name and telephone number) (914) 332-0222

Dated: 26th April 2000	Inventor's Signature: *Matthew P. J. Baker*	
FULL NAME OF INVENTOR	Last name: BAKER	First Name: Matthew	Middle Name: P.J.
RESIDENCE & CITIZENSHIP	City: CANTERBURY	State or Foreign Country: KENT	Country of Citizenship: GREAT BRITAIN
POST OFFICE ADDRESS	Street & No.: 12, FIR TREE CLOSE	City: ROUGH COMMON, CANTERBURY	State or Country: KENT, UK	Zip Code: CT2 9DB

Dated: 27th April 2000	Inventor's Signature *Edward S. Eilley*	
FULL NAME OF INVENTOR	Last name: EILLEY	First Name: Edward	Middle Name: S.
RESIDENCE & CITIZENSHIP	City: REIGATE	State or Foreign Country: ENGLAND	Country of Citizenship: GREAT BRITAIN
POST OFFICE ADDRESS	Street & No.: THE FIRS, OAK WAY	City: REIGATE	State or Country: SURREY U.K.	Zip Code: RH2 7ES

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	Atty. Docket
MATTHEW P.J. BAKER ET AL	PHB 34,348
Serial No.	Group Art Unit:
Filed: CONCURRENTLY	Examiner:

METHOD OF, AND HETEROGENEOUS NETWORK FOR, TRANSMITTING DATA PACKETS

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

APPOINTMENT OF ASSOCIATES

Sir:

The undersigned Attorney of Record hereby revokes all
prior appointments (if any) of Associate Attorney(s) or Agent(s) in
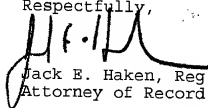the above-captioned case and appoints:
DANIEL J. PIOTROWSKI **(Registration No. 42,079)**
c/o U.S. PHILIPS CORPORATION, Intellectual Property Department, 580
White Plains Road, Tarrytown, New York 10591, his Associate
Attorney(s)/Agent(s) with all the usual powers to prosecute the
above-identified application and any division or continuation
thereof, to make alterations and amendments therein, and to
transact all business in the Patent and Trademark Office connected
therewith.

ALL CORRESPONDENCE CONCERNING THIS APPLICATION AND THE
LETTERS PATENT WHEN GRANTED SHOULD BE ADDRESSED TO THE UNDERSIGNED
ATTORNEY OF RECORD.

Respectfully,

Jack E. Haken, Reg. 26,902
Attorney of Record

Dated at Tarrytown, New York
this 23RD day of MAY, 2000